Royal HaskoningDHV
Enhancing Society Together

U.S. Department of Transportation
Federal Highway Administration

DUTCH CYCLING EMBASSY

Thinkbike workshop Streetscape design

Arie Vijfhuizen

Content of this presentation

1. Sections and junctions
   - Design bicycle path / lane / street
   - Sections
   - Junctions

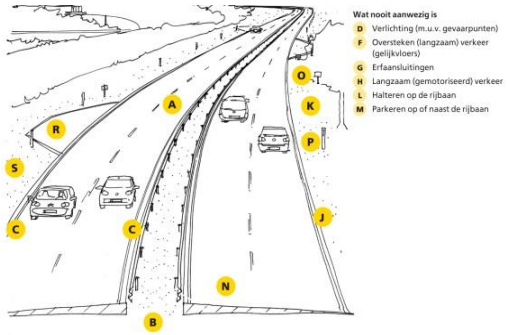
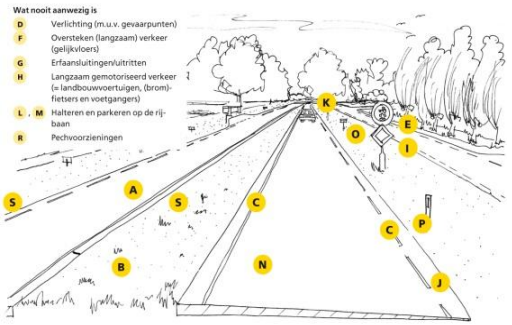
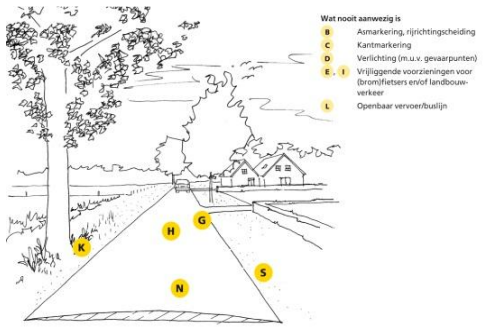
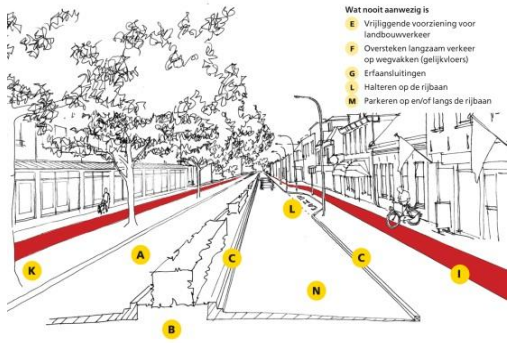
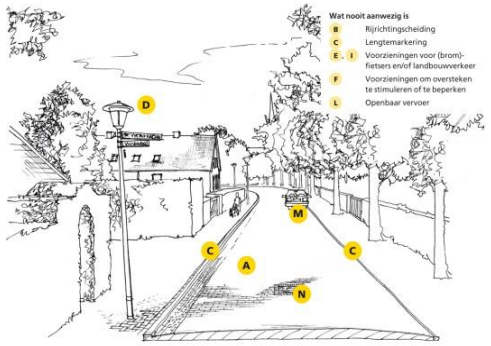
2. Priority

3. Roundabouts

4. Maintenance

Sections and Junctions

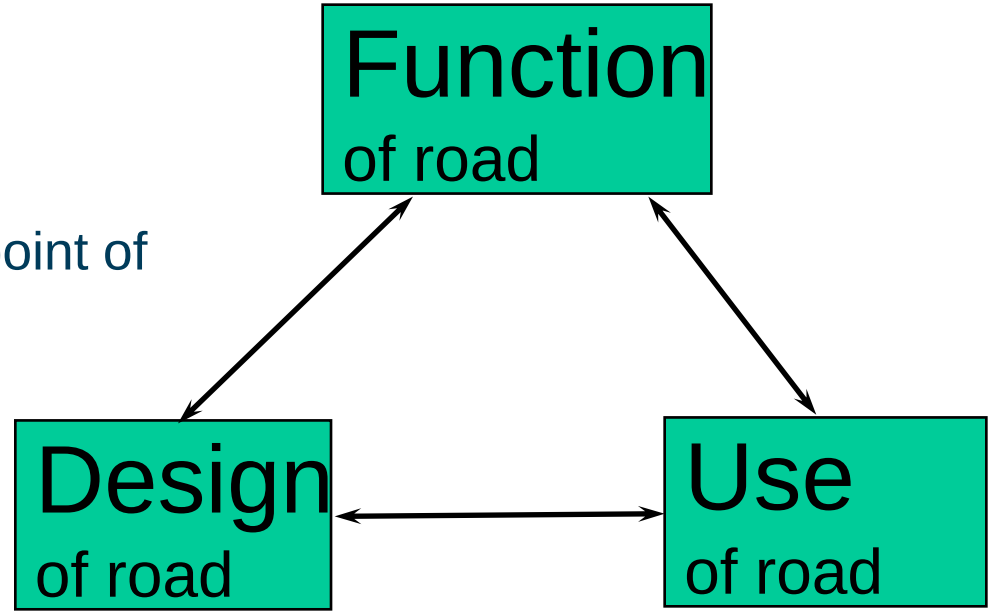
Base points road design

	Stroomweg	Gebieds-Ontsluitingsweg (optimaal)	Erftoegangsweg (optimaal)
Buiten de bebouwde kom			
Bebouwde kom			

How to design Bicycle Facilities

Sustainable Safety

Function, form and use
in balance, from road safety point of view



function:	use of the road as intended by the road authority
design:	the physical design and layout properties of the infrastructure
use:	actual use of the infrastructure and behaviour of the road user

How to design Path / lane

Choose type of solution:

- Bicycle path or lane or bicycle street
- With or without mopeds
- One or two way bicycle traffic

Most important aspects:

- Separation
- Width
- Surface

Sections

Separation

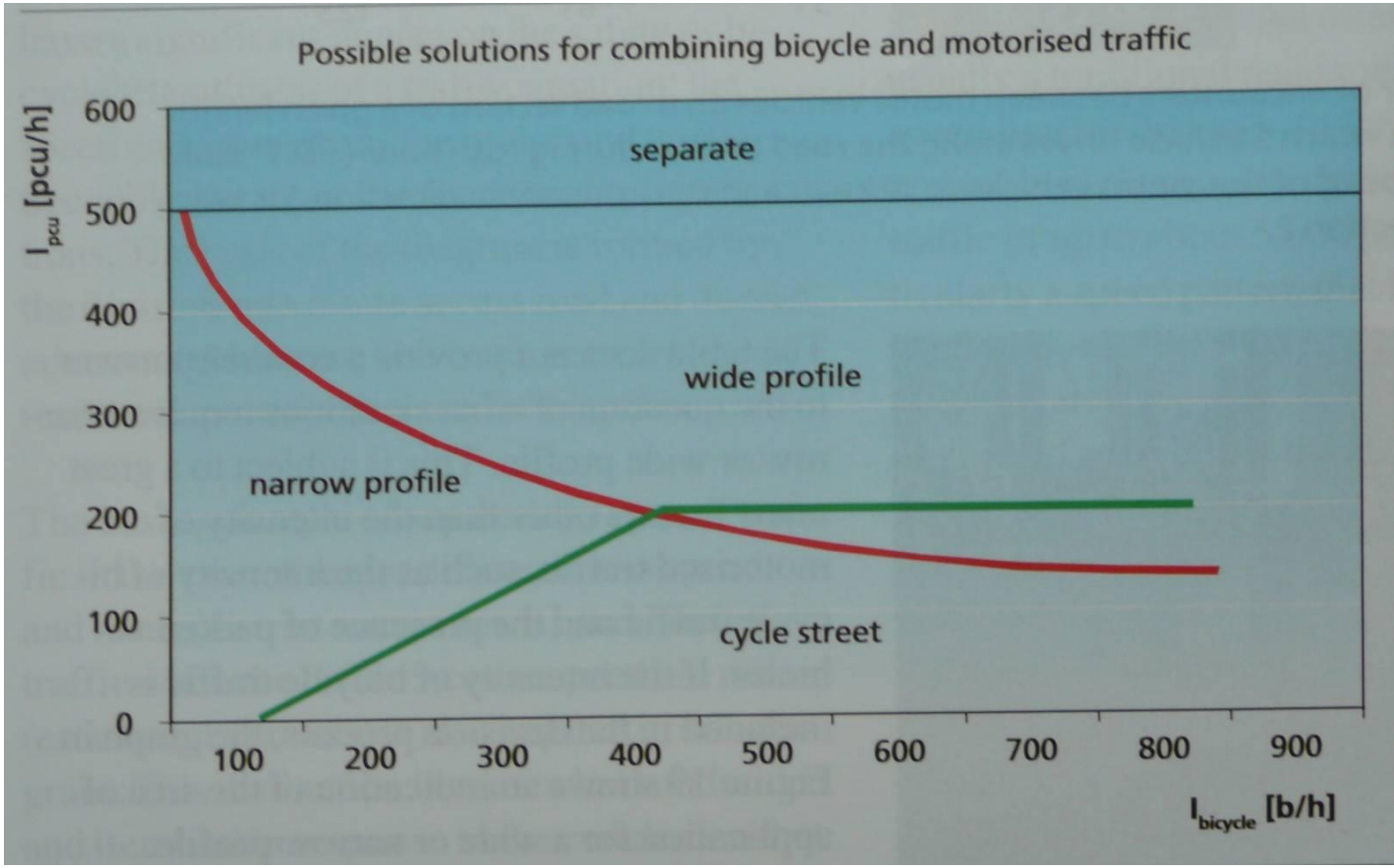
Distributor road Access road

Table 14. Option diagram for road sections inside the built-up area

Road category	Max. speed of motorised traffic (km/h)		Motorised traffic intensity (pcu/day)	Cycle network category: basic network ($I_{bicycle}$ > work 750/day)	cycle route ($I_{bicycle}$ 500-2500/day)	main cycle route ($I_{bicycle}$ > 2000/day)
	n/a		0	solitary track		
Estate acces roead	walking pace or 30 km/h		1 - 2.500	combined traffic		cycle street or cycle lane (with right of way)
			2.000 - 5.000			
			> 4.000	cycle lane or cycle track		
District acces road	50 km/h	2x1 lanes	irrelevant	cycle track or parallel road		
		2x2 lanes				
	70 km/h			cycle track,moped/cycle track or parallel road		

Sections

Separation / combined use



Bicycle path / track

Separate path:
Distributor roads
Main bicycle routes
Car parking
Physical space

- Function ▸width, surface
- Volume of cyclists ▸width
- Mopeds ▸width
- One or two way ▸width

Bicycle path / track

Examples: Separate bicycle path

Bicycle path / track

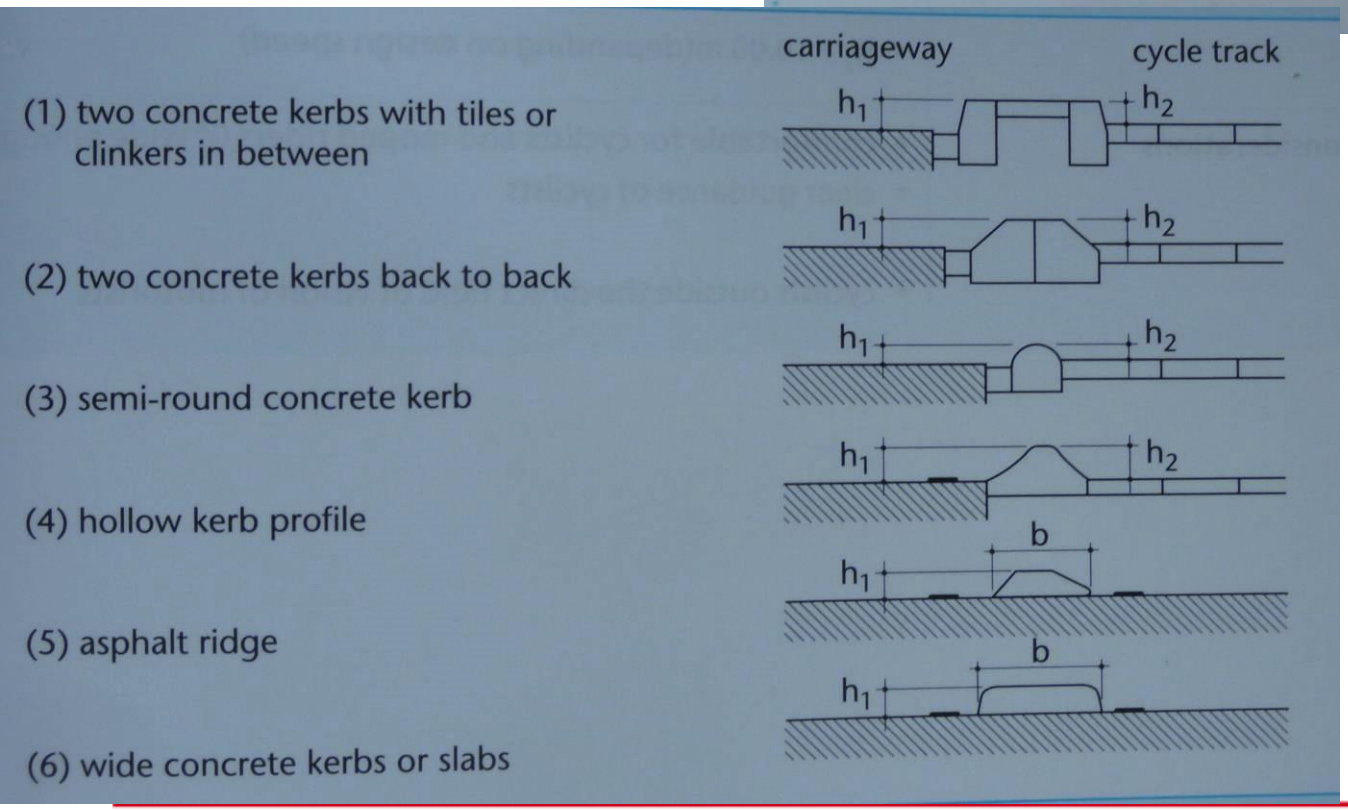
Partition verge

- at least 0.35 m
- in the presence of lamp posts and/or two-way cycle track > 1.00 m
- in the case of vegetation or parking > 2.30 m
- from 30 m before side road < 0.35 m (for roads with V_{max} < 70 km/h)
- with fence > 0.70 m
- with barrier > 1.10 m

Bicycle path / track

Partition verge (insufficient space)

- width varies
- $h_1 \leq 0.10$ to 0.12 m
- $h_2 = 0.05$ (0.07) m; if 0.07 m, choose a profile that prevents pedals striking the separation



Bicycle lane

Bicycle lane:

- Little space ▸low volume / speed
- Car parking ▸too high → no lanes
- Function ▸width
- Volume of cyclists ▸width

Bicycle lane

Bicycle lane:

- Red colour
- Continuous line: 2.00 – 2.50 m
- Interrupted line: 1.50 – 2.00 m

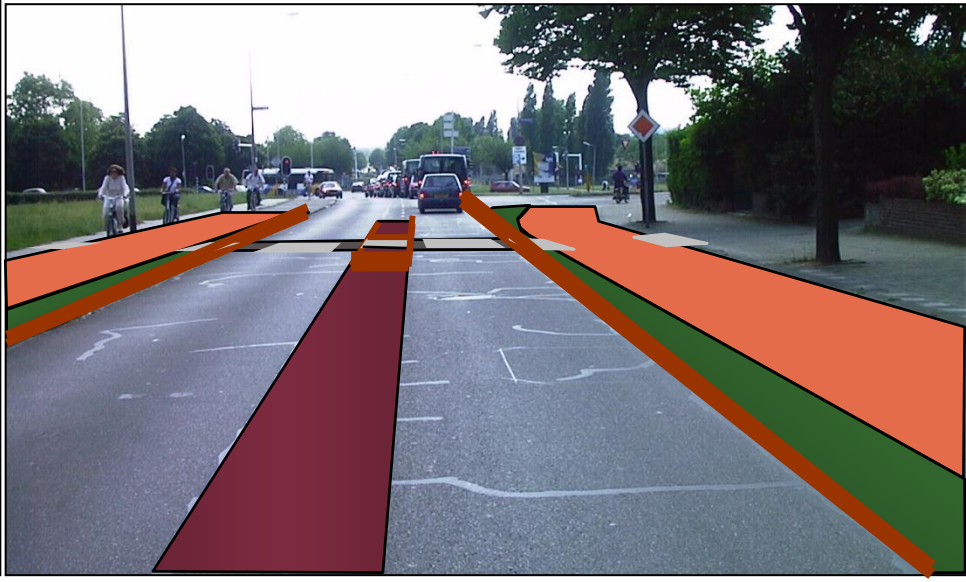
Bicycle lane

Examples: Bicycle lanes

Bicycle lane

Up grade from lane to path:

- without using extra space



Bicycle street

Bicycle street:

- Two directions
- Red colour
- No signs

- Maximum 200 pcu/hr
- Speed reduction

Shared use

Alternative: do nothing
(combined use)

- Speed reduction

20 m/h zone

Traffic calming
- Speed
- Volume

When is shared use acceptable?

Table 14. Option diagram for road sections inside the built-up area

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District access road	50 km/h	2x1 lanes	irrelevant		cycle track or parallel road	
		2x2 lanes				
	70 km/h			cycle track,moped/cycle track or parallel road		

Shared Space

Motor vehicles, cyclists and pedestrians

No or very little visible segregation

Junctions

How to design junction / crossing

Choose type of solution:

- Give way + additions
  (refuge island, speed hump, narrowing)
- Roundabout
- Traffic lights
- Grade separate (bridge, tunnel)
- Do nothing (or just add minor adjustments)

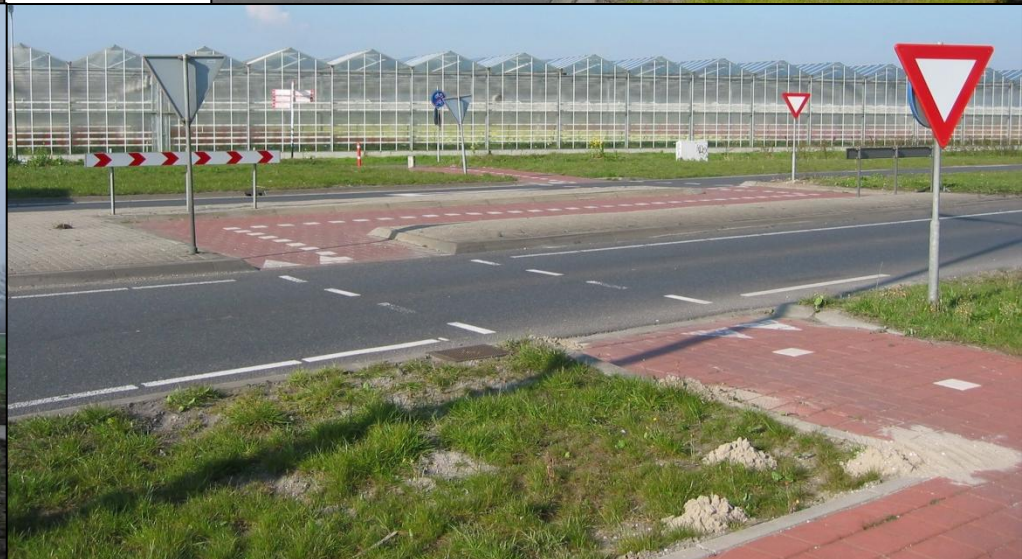
Junction / crossing

Additions:

- Speed hump / plateau
- Refuge island
- Narrowing
- Bollards
- Public Lighting
- Continuous material, colour

Junction / crossing: Give way

Examples: Separate crossing

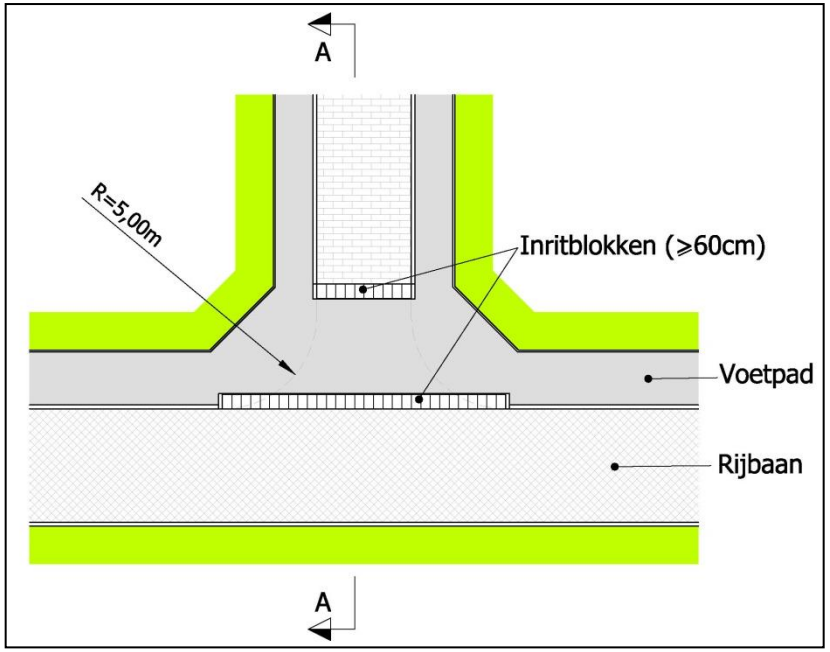


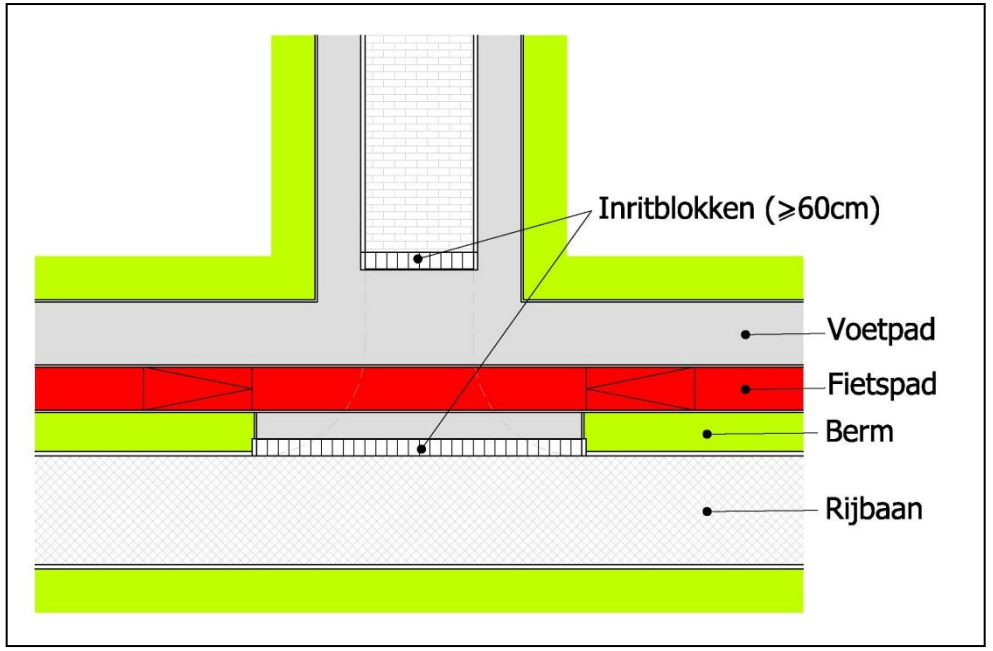
Junction / crossing: Give way

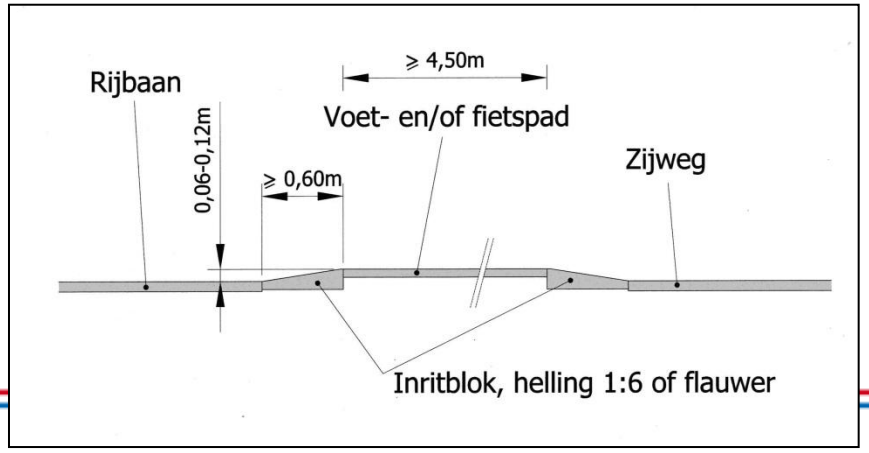
Examples: Give way

Arterial road 50 km/h – 30 mph

Back street – Arterial road



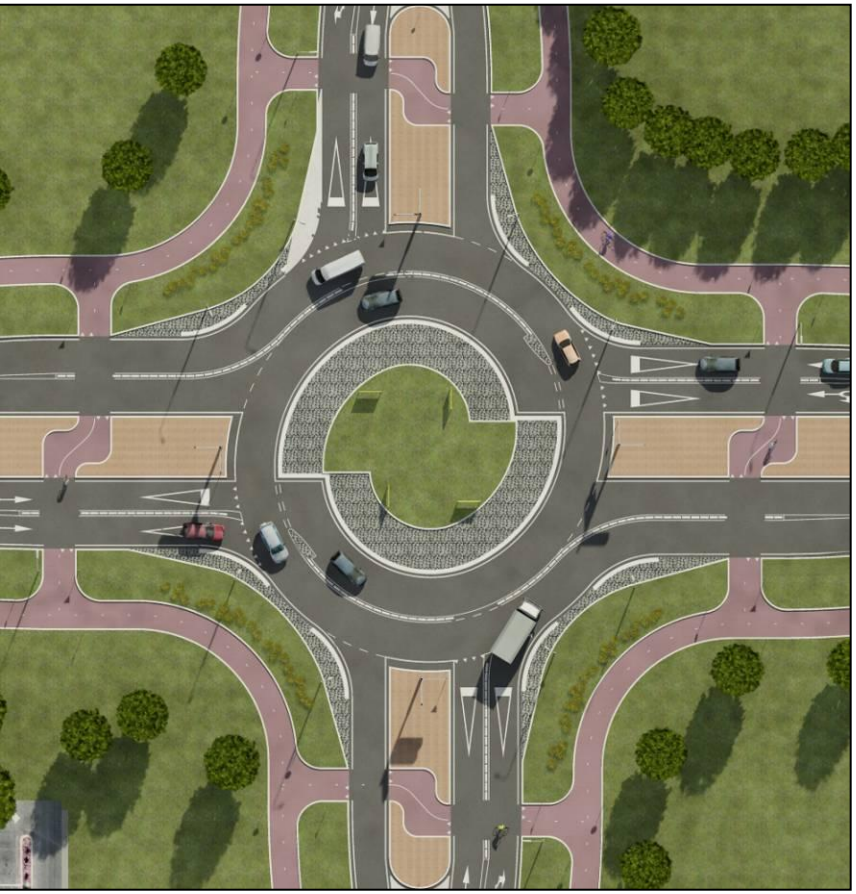




Back street – Arterial road

Junction / crossing: Roundabout

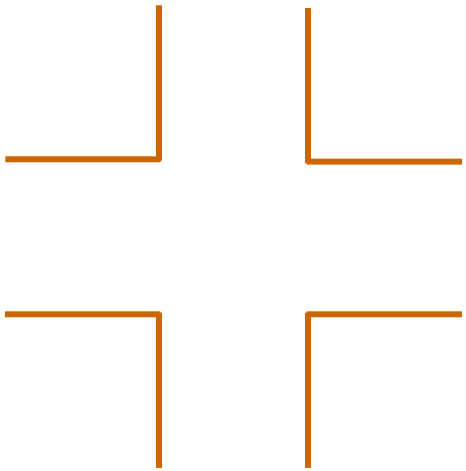
Multi lane roundabout:



Single lane roundabout:

Junction / crossing: Traffic lights

Bicycle friendly additions:



1	shorten cycle time
2	include additional green light options for cyclists
3	permit right turn through red
4	give all cycling directions a green light at the same time
5	accept motorised vehicle/ bicycle sub-conflicts
6	set favourable standby time for cyclists
7	increase cycling directions with priority along with public transport
8	increase cycling directions with priority along with other directions
9	set favourable phase sequence for cyclists turning left
10	set green wave for bicycle traffic
11	keep mutual conflicts between slow traffic outside of the control
12	implement right turn through red
13	introduce long distance detection/pre-request for cycle traffic
14	introduce ECSL
15	increase flow capacity for motorised traffic
16	set two-way green light

Junction / crossing: Traffic lights

Examples bicycle friendly adds

Green wave

Rain sensitive traffic lights

Junction / crossing: Traffic lights

Examples bicycle friendly adds

All directions green

Waiting time predictors

Junction / crossing: Traffic lights

Examples bicycle friendly adds

Junction / crossing: Grade separate

Bridge or tunnel?

- Bridging ▸tunnel
- Comfort ▸tunnel
- Ecological ▸tunnel
- Social safety ▸bridge
- Costs ▸bridge
- Spatial fit
  - ▸tunnel: “invisible”
  - ▸bridge: architectural pleasing

Option: half bridge, half tunnel

Junction / crossing: Grade separate

Examples bridge / tunnel

Priority

Priority

Can cyclists have priority to cars?

Main issue: safety

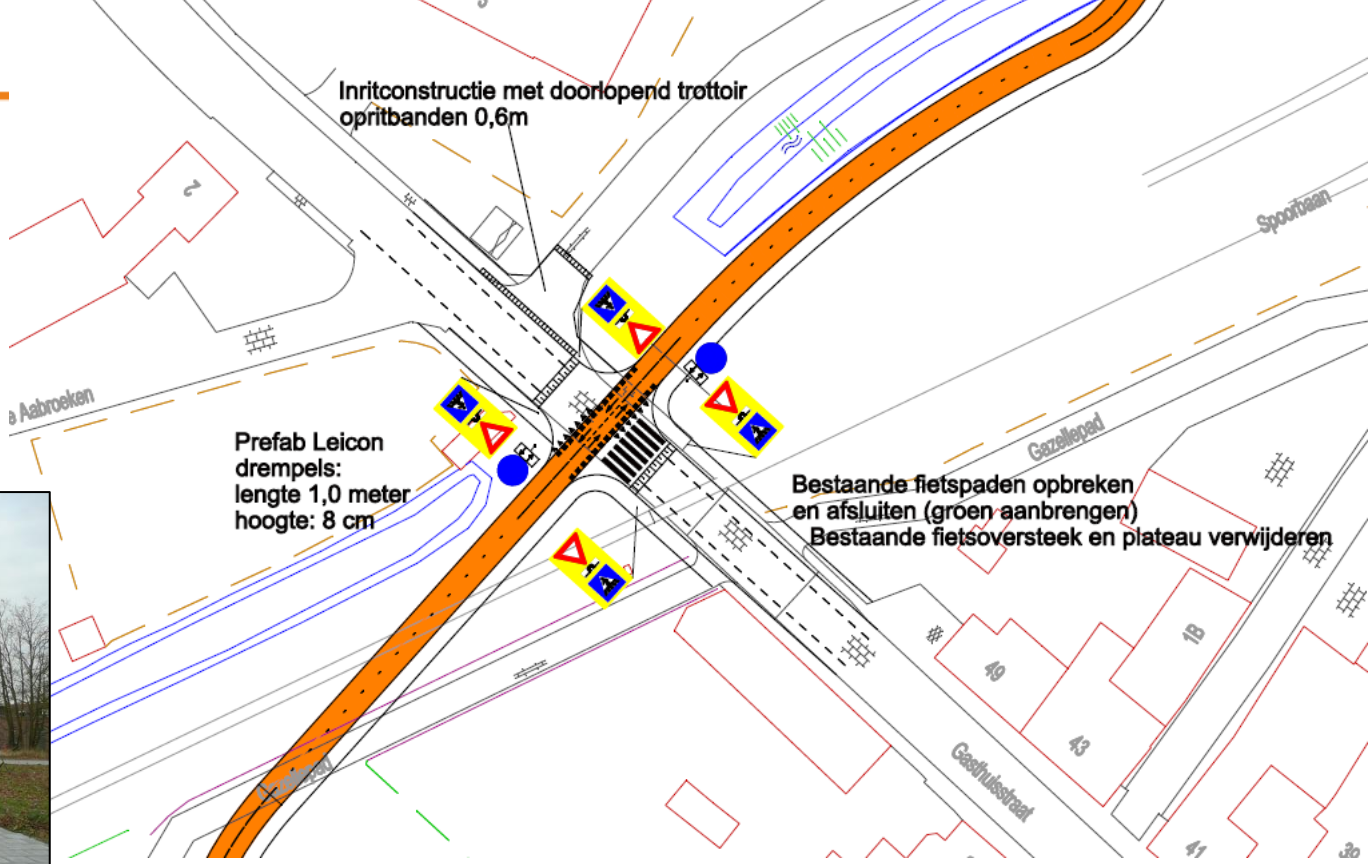
Priority

Volume bicycles		Volume MVH		Speed MVH		Priority
low	high	low	high	low	High	
✔		✔		✔		
	✔	✔		✔		
✔			✔	✔		
	✔		✔	✔		
✔		✔			✔	
	✔	✔			✔	
✔			✔		✔	
	✔		✔		✔	

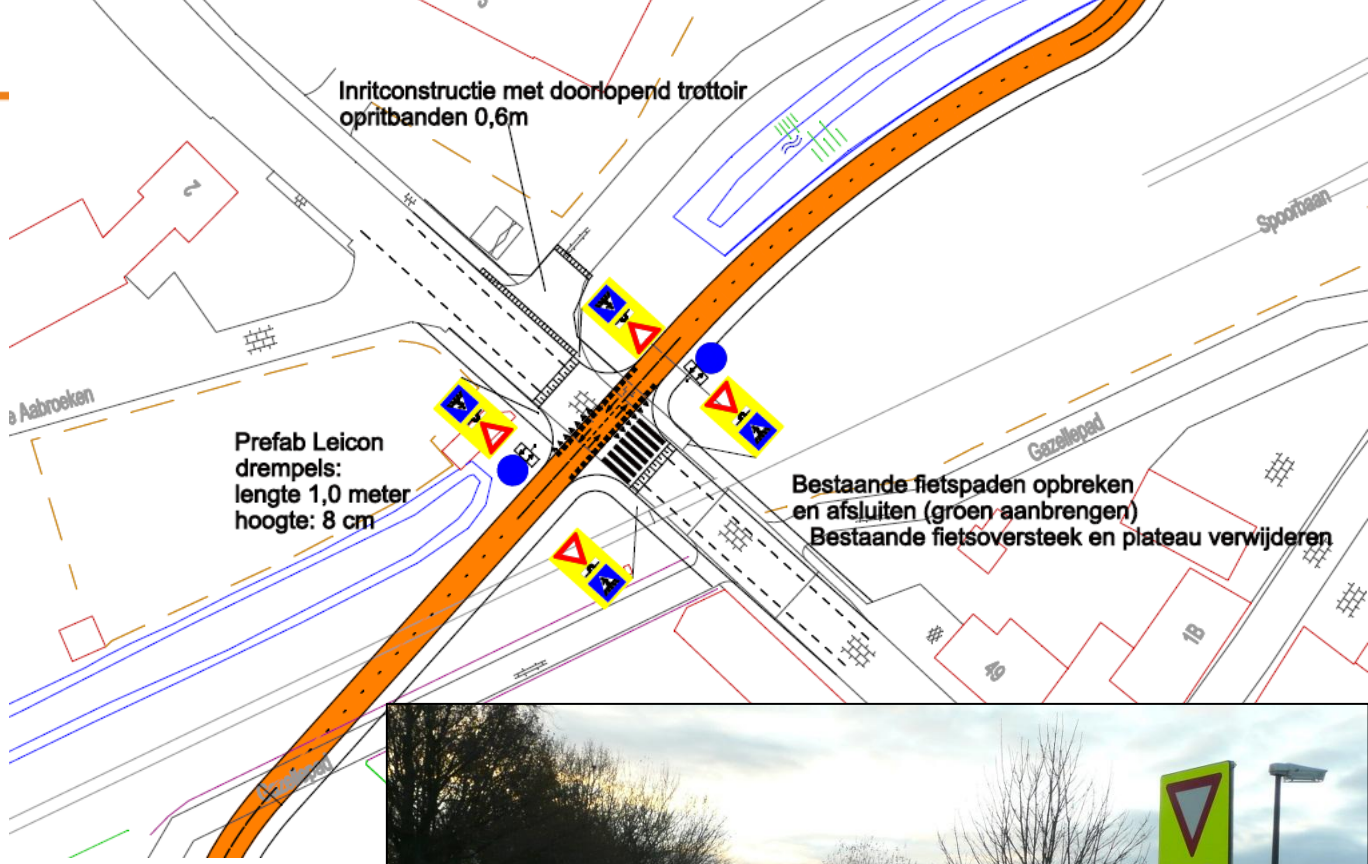
Priority

Priority

Priority


Inritconstructie met doorlopend trottoir
opritbanden 0,6m
Prefab Leicon
drempels:
lengte 1,0 meter
hoogte: 8 cm
Bestaande fietspaden opbreken
en afsluiten (groen aanbrengen)
Bestaande fietsoversteek en plateau verwijderen
Spoorbaan
Gazellepad
Gasthuisstraat
49
43
1B
41

Priority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Bestaande fietsoversteek en plateau verwijderen
Spoorbaan
Gazellepad
Aebroeken

Roundabouts

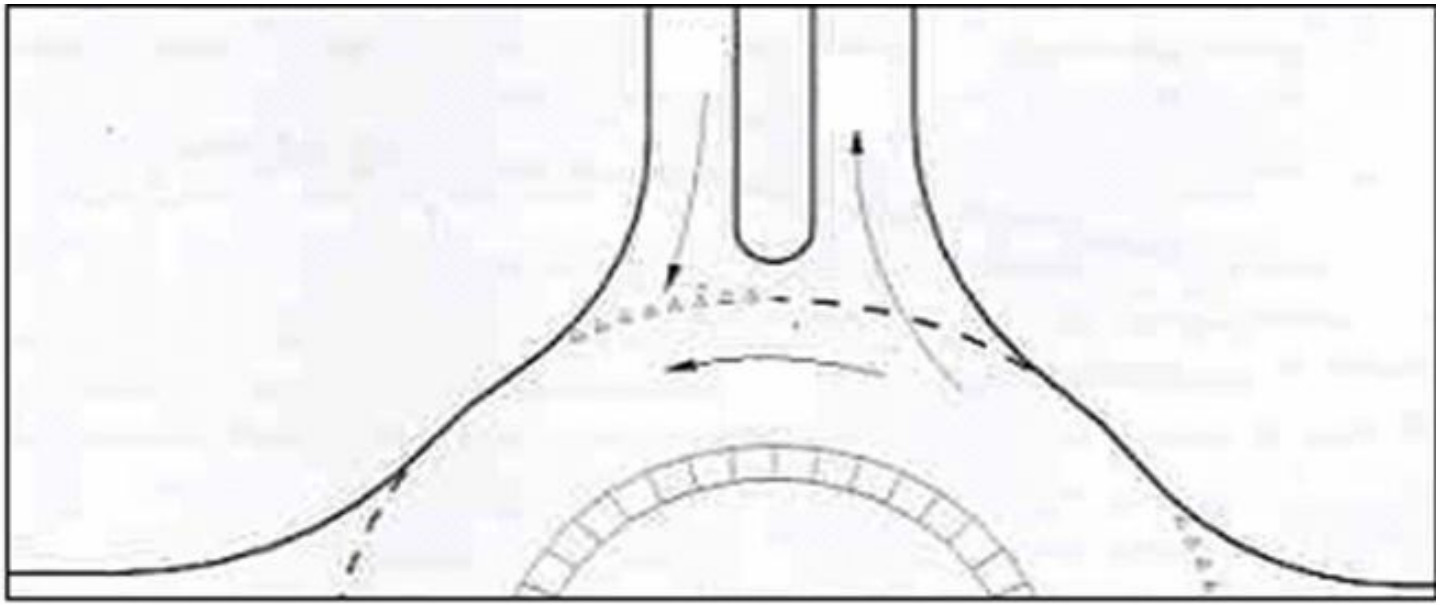
Why do we built roundabouts?

- High capacity
- Safe → low speeds

Capacity

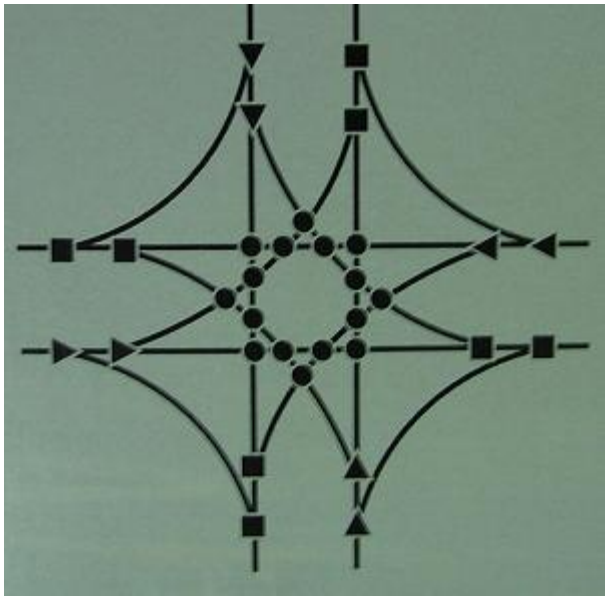
Typical capacity per type of roundabout

- single lane roundabout 25.000 veh/24h
- two-lane roundabout, single lane exits 30.000 veh/24h
- two-lane roundabout, two-lane exits 40.000 veh/24h
- turbo roundabout 60.000 veh/24h

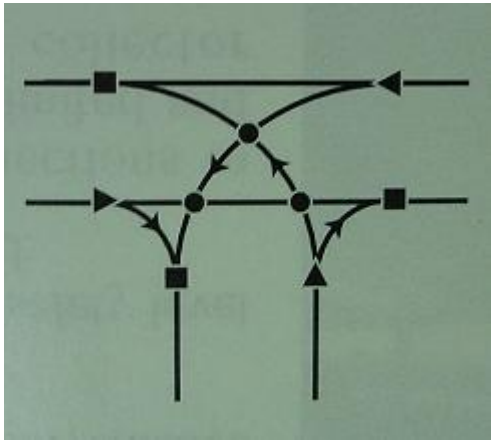


Safety

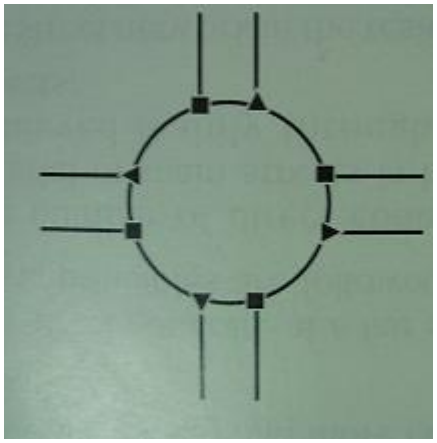
- Main safety advantages of roundabouts
  - actual speed is low
  - the number of conflicts is reduced
  - no crossing conflicts
  - predictable behavior (keeping lanes)



32 conflicts



9 conflicts

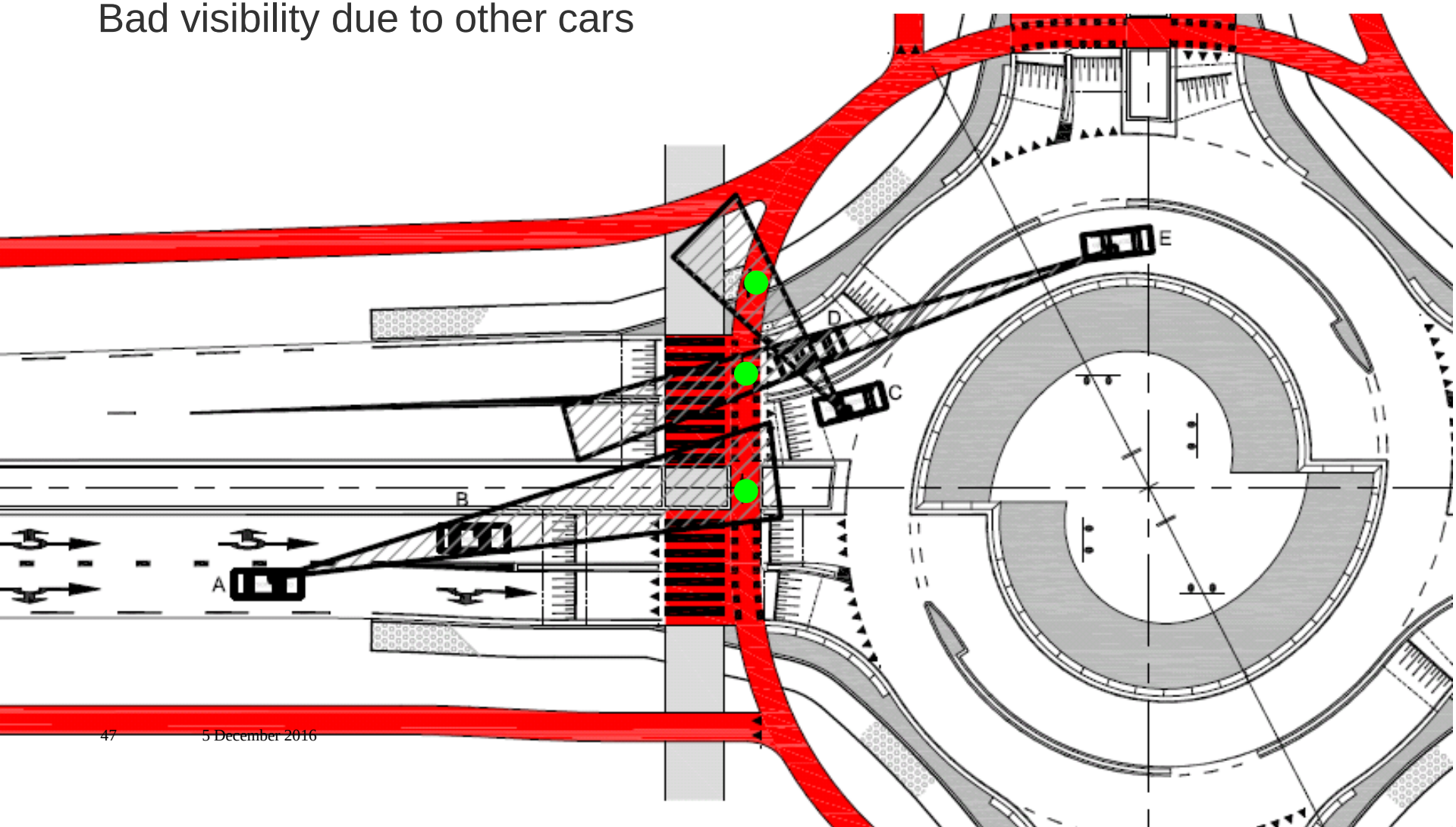


8 conflicts

▲ diverging ■ merging ● crossing

Typical accident type

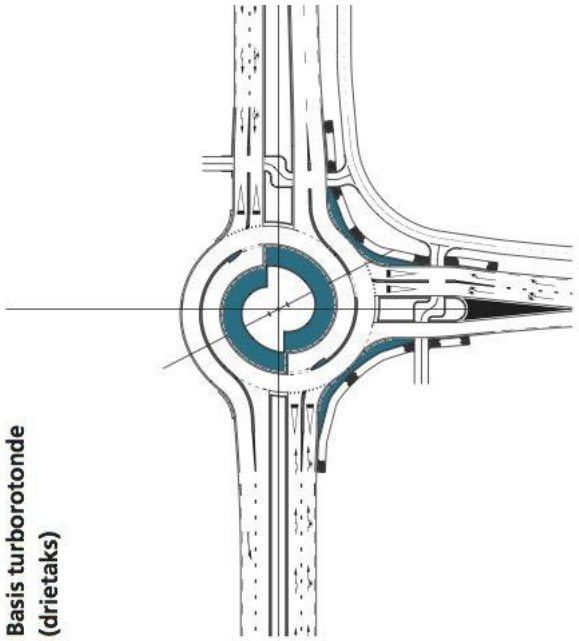
On turbo roundabouts with give way to BICYCLES:
Bad visibility due to other cars



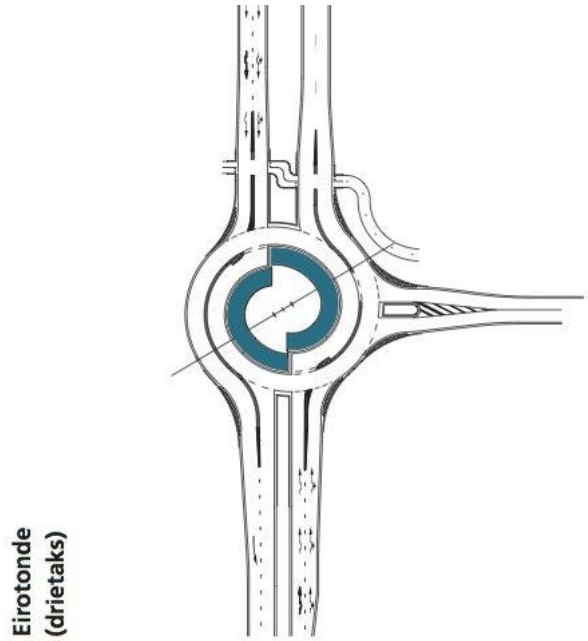
Bicycle friendly roundabout design

Safe: Blind spot

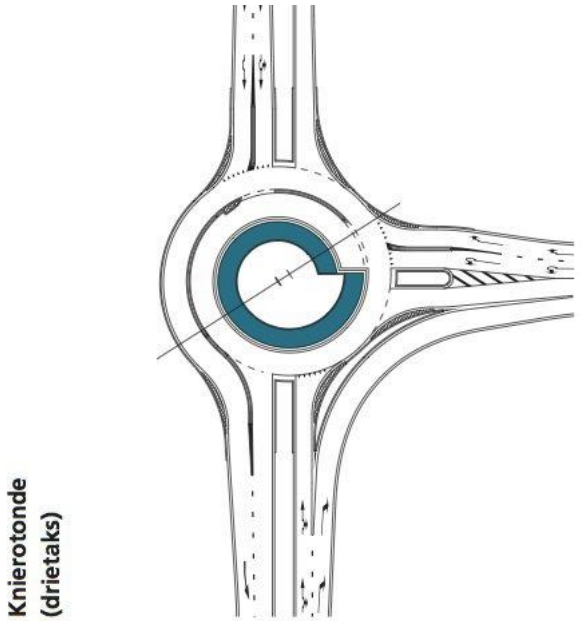
Roundabout types



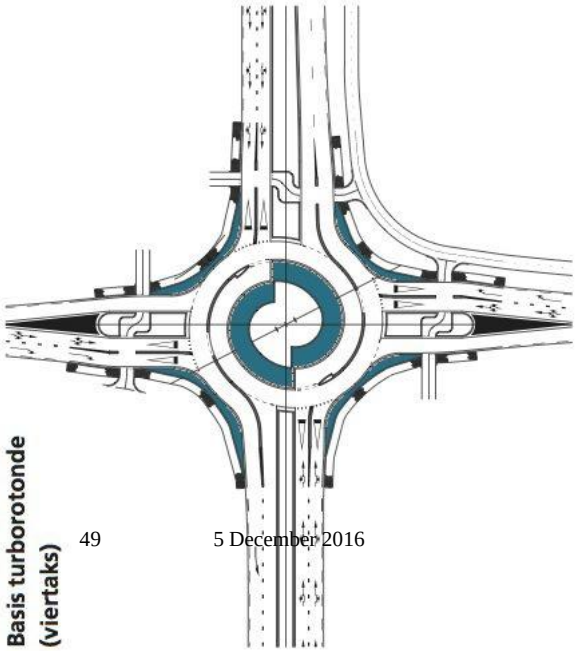
Basis turborotonde (drietaks)



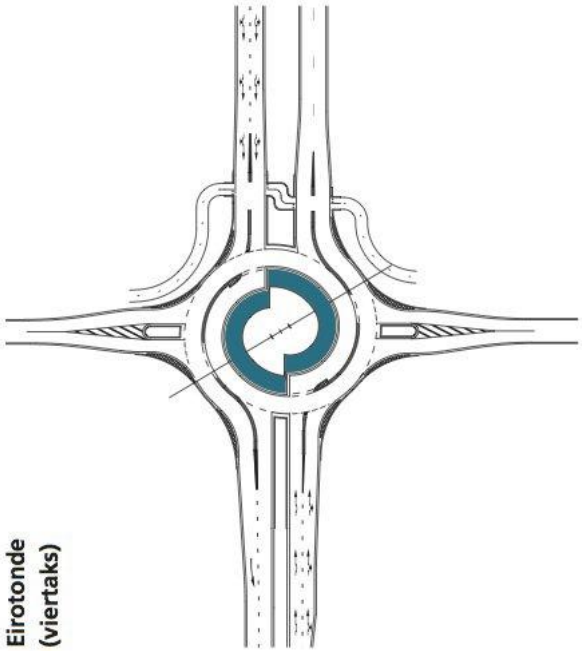
Eirotonde (drietaks)



Knierotonde (drietaks)



Basis turborotonde (viertaks)



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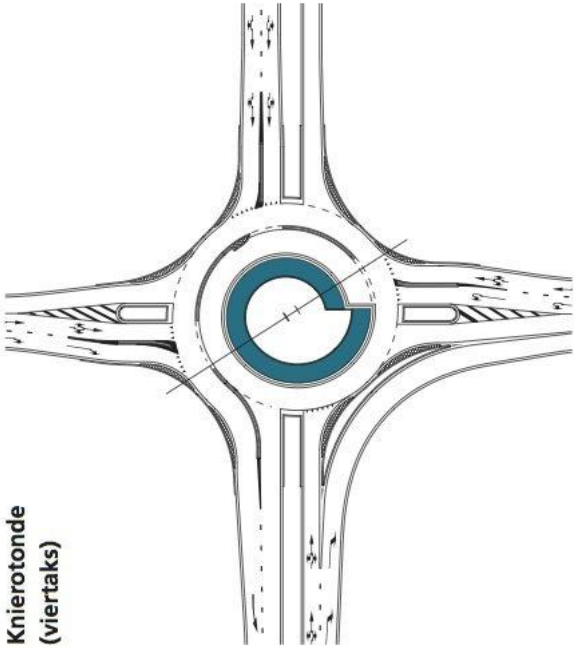
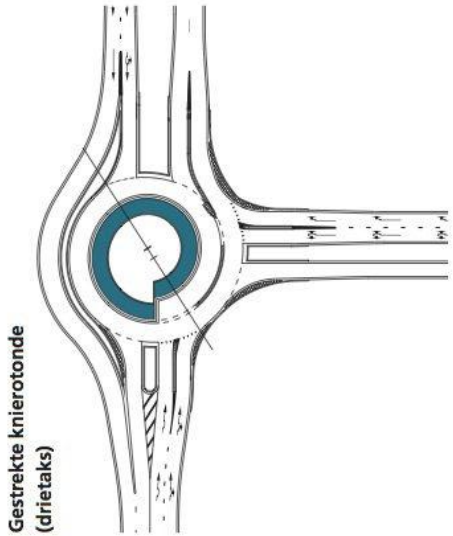
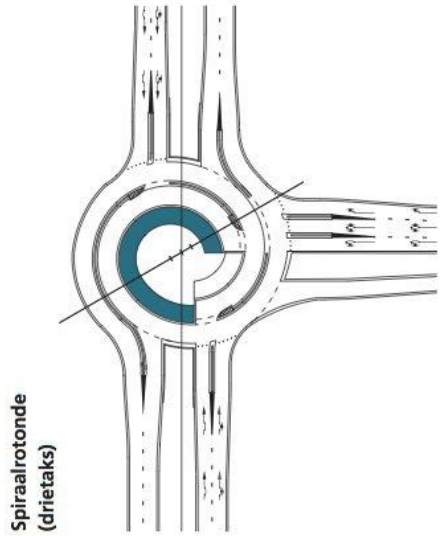
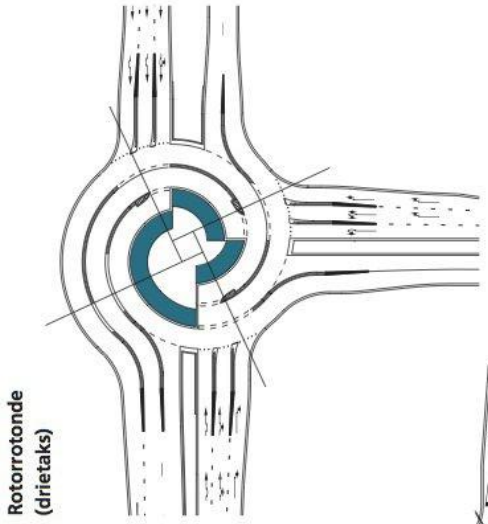


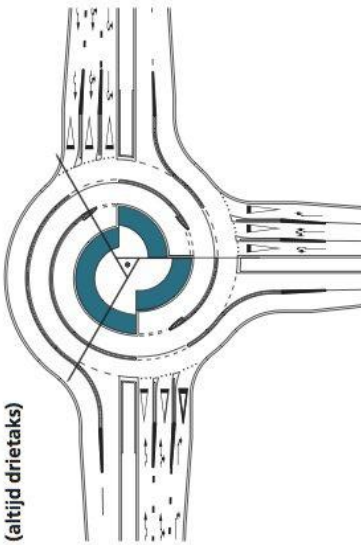
Knierotonde (viertaks)

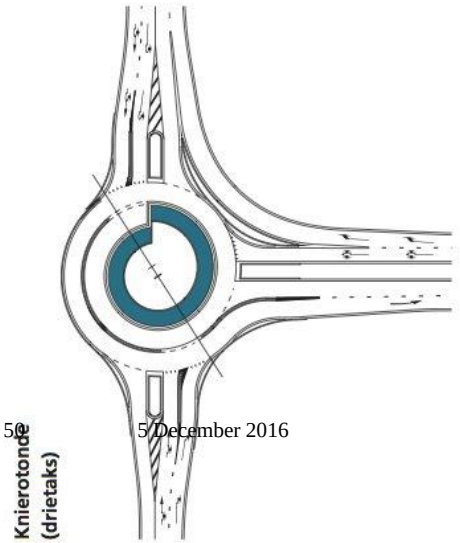
Roundabout types

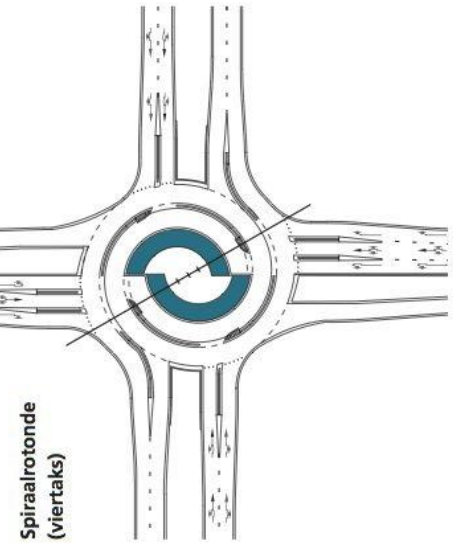


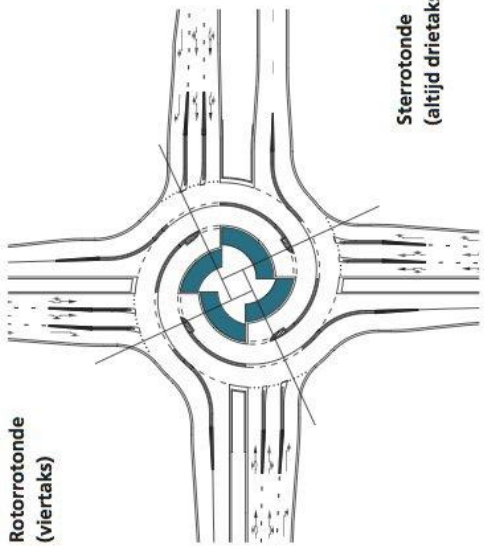




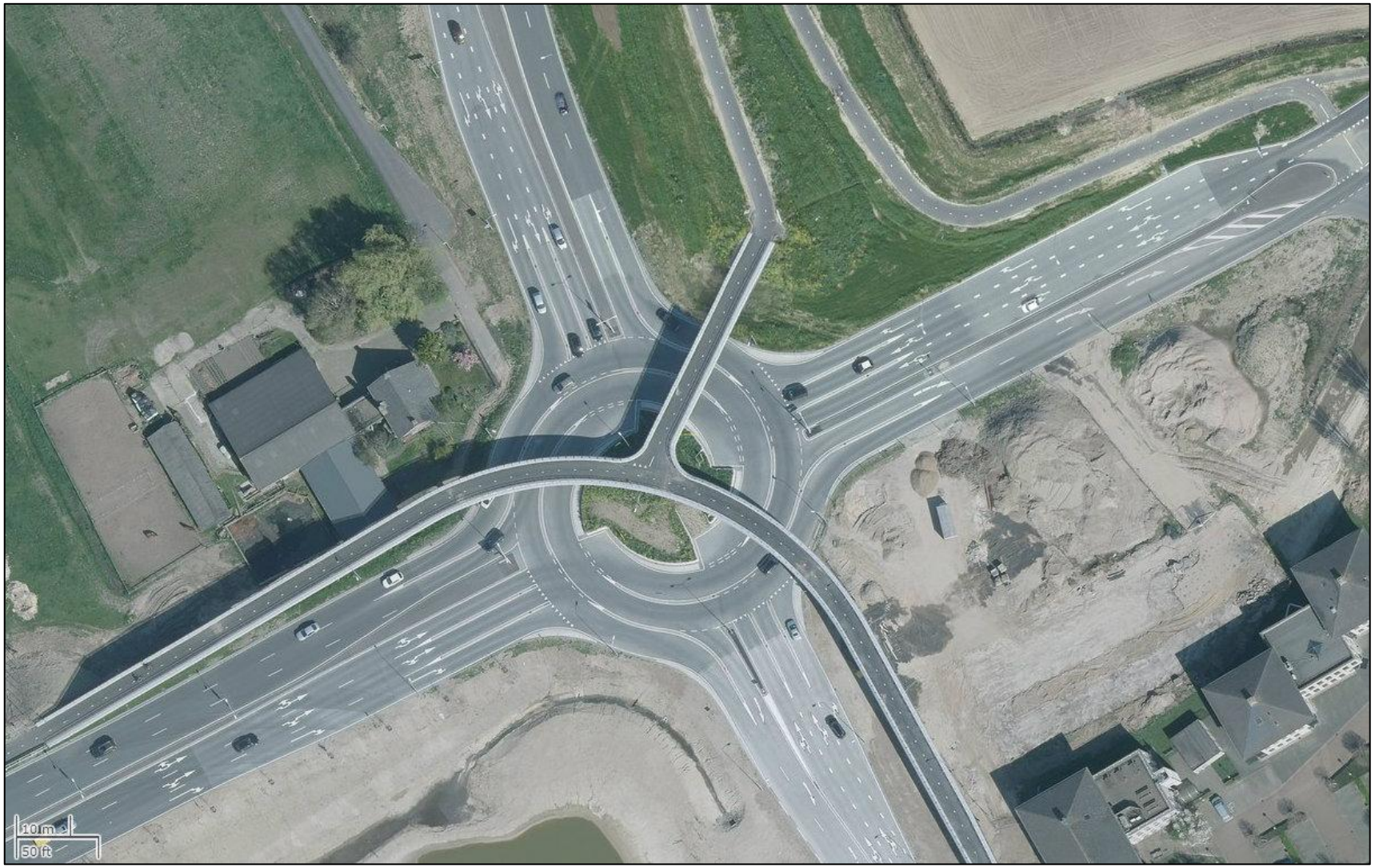






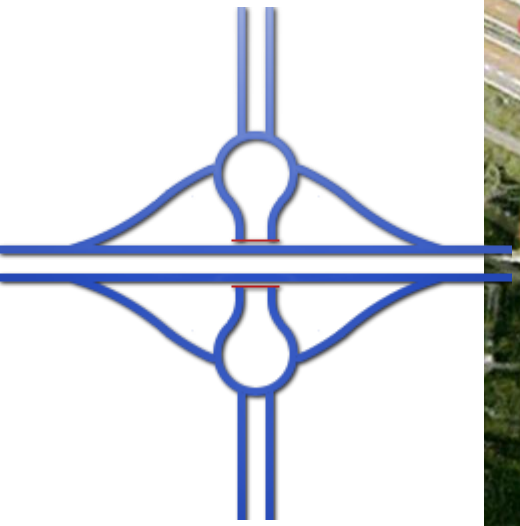


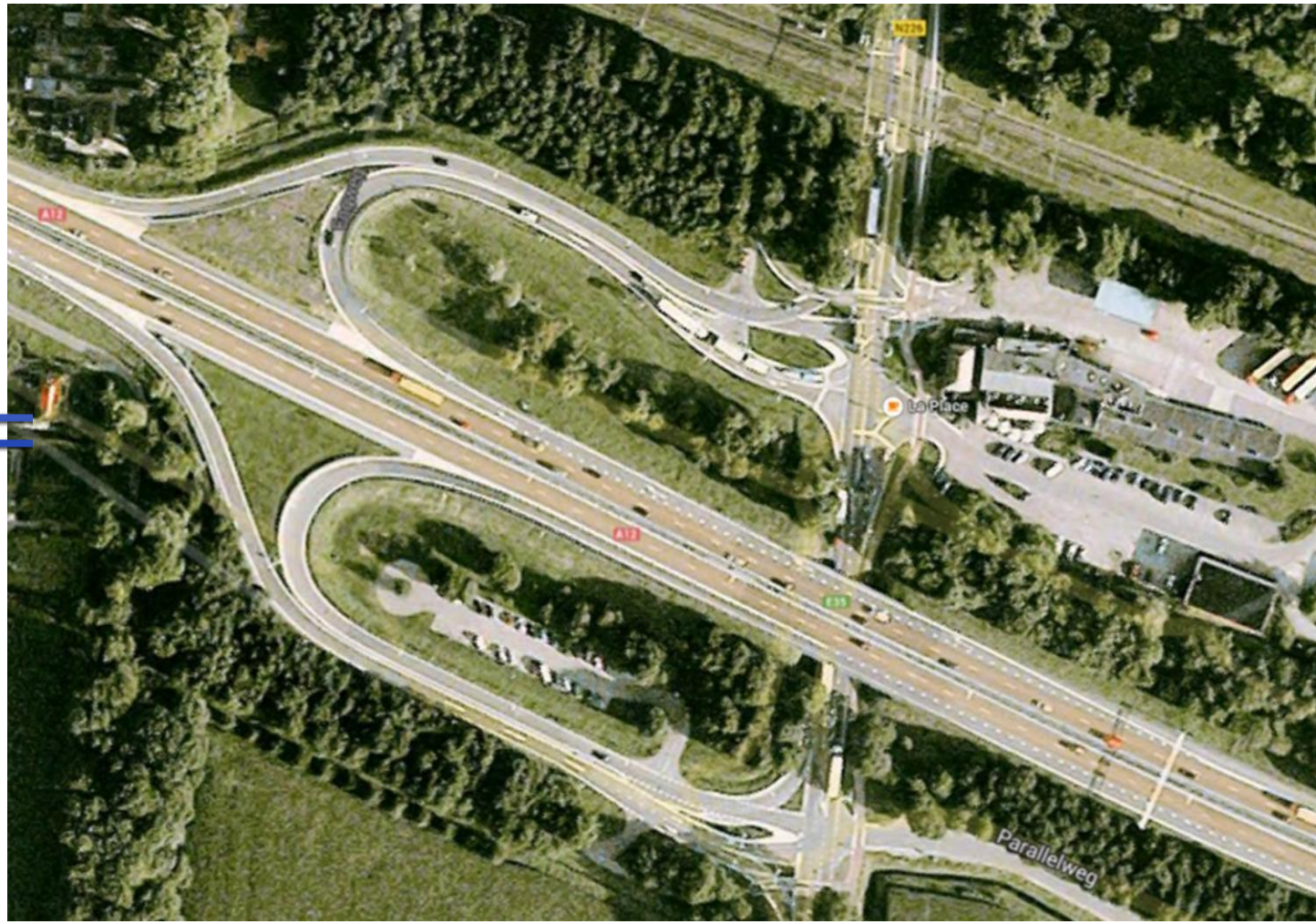
Examples: Rosmalen 1



Examples: Rosmalen 2

Examples: Maarsbergen 1





Examples: Maarsbergen 2

Examples: Maarsbergen 3

Examples: Eindhoven by night

Examples: Eindhoven by day

Examples: Leeuwarden

Examples: Den Bosch

Examples: Hilversum Mediapark

Examples: Poland

Examples: Swindon England - magic

Maintenance

Maintenance

Potholes

Maintenance

Potholes

Rims (curb stones)

Maintenance

Potholes
Rims (curb stones)
Smooth surface

Maintenance

Potholes
Rims (curb stones)
Smooth surface
Drainage

Maintenance

Potholes
Rims (curb stones)
Smooth surface
Drainage
Winter maintenance

Maintenance

Potholes
Rims (curb stones)
Smooth surface
Sewerage (?)
Winter maintenance
Marking

Maintenance

Potholes
Rims (curb stones)
Smooth surface
Sewerage (?)
Winter maintenance
Marking

Any questions?

End of my presentation